DEMOSPONGES OF THE HOUTMAN ABROLHOS

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The Houtman Abrolhos lie off the west coast of Australia within a biogeographic zone that has overlapping temperate and tropical components, and a significant proportion of endemic species. The islands are situated in the path of the warm, southward flowing Leeuwin current. Studies on marine biota of these islands found a dominant tropical component to the fauna. Marine sponges of the Houtman Abrolhos are poorly studied. A field program was established to collect sponges, document the biodiversity, and determine if this biota was principally tropical or temperate in origin. 77 demosponge species are reported from the two localities examined in this study, 28 of which are known to science, 14 are identified to known species but require confirmation by comparison with type material, and 35 species are probably new. Three genera are reported for the first time from Australia. This study brings the total number of demosponge species documented from the Houtman Abrolhos to 109. Preliminary assessment of tropical versus temperate affinities indicated more species of temperate than tropical origin were present. This is contrary to comparable studies on other components of the marine biota of these islands. ❐ *Porifera, Demospongiae, Houtman Abrolhos, Western Australia, biogeography.*

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The Houtman Abrolhos (herein referred to as the Abrolhos) are 65-90km off the W coast of Australia at 28°-29°S, 113°35'-114°03'E, near the edge of the continental shelf (Wells, 1997). There are 122 islands in 4 island groups (Fig.1).

The marine habitats of these islands are unique. 1) They are the southernmost area of major coral reef development in the eastern Indian Ocean (Wells, 1997). 2) There is a co-dominance of reef building corals and macroalgae in the upper photic zone. Macroalgae (often *Ecklonia*) dominates on windward (W facing) reefs and hard coral (*Acropora*) on leeward slopes. In some lagoons there may be a mixture of the two community types (Wells, 1997). 3) The western rock lobster, *Panulirus cygnus*, a species endemic to Western Australia, is commercially fished in the Abrolhos system. This is a seasonal fishery at the Abrolhos open for three months each year when the fishers and their families occupy huts on the islands (Wells, 1997). For the rest of the year the islands are largely unoccupied. 4) The islands have high conservation value. In 1994 the Marine Parks and Reserves Selection Working Group acknowledged the islands as the most significant area on the WA coast, and the most worthy of reservation (Anon., 1994).

These islands are considered to be within, and towards, the northern limit of the Western Overlap Zone (Wells, 1997), a biogeographic region on the WA coastline which has temperate and tropical components, and a significant proportion of endemic species. Studies on the marine biota of the islands found a higher proportion of northern tropical species than southern temperate species, compared to the adjacent mainland coastline at Geraldton. This high proportion of tropical species in the Abrolhos is due to the southward flowing Leeuwin Current, which carries tropical water from NW Australia (Cresswell & Golding, 1980). This is a relatively warm seasonal current that flows southward most strongly in autumn and winter, hence retaining higher sea temperatures at the islands than in adjacent mainland coastal waters (Pearce, 1997). However, geographically these islands are temperate, hence the co-occurrence of both tropical and temperate species.

The aims of this study were to document the poorly known demosponge fauna of these islands, to assess their biogeographic affinities, and to compare their biogeography to other marine phyla reported from there.

Seven previous publications have reported on the sponge fauna of these islands, with a total of 57 demosponges described from the Abrolhos prior to this study (Table 1).

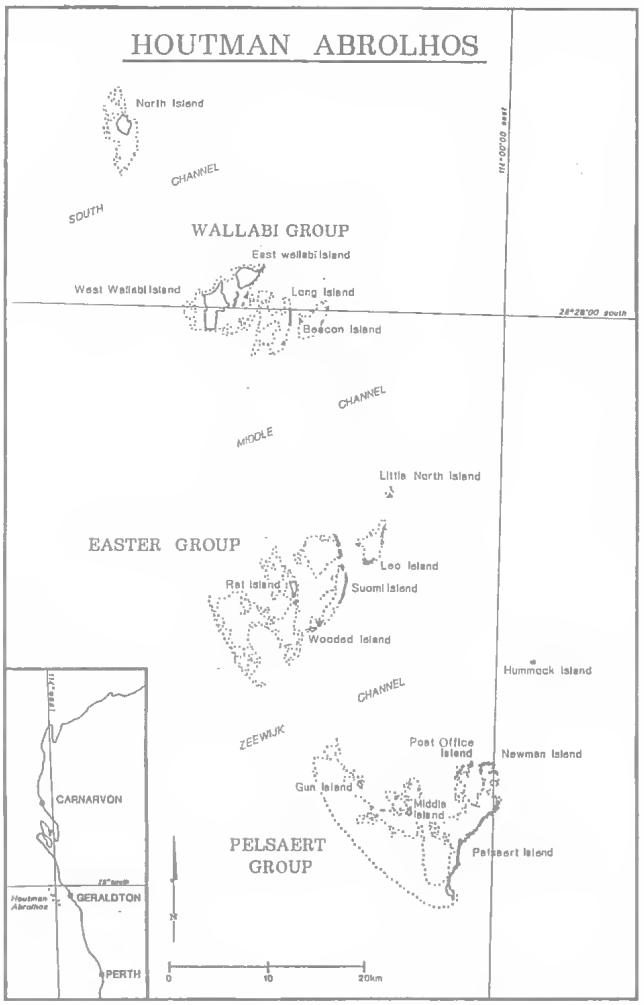

FIG. 1. Map of the Houtman Abrolhos. (Reproduced with permission of Fisheries Western Australia)

TABLE 1. Publications on Demosponges reported from the Abrolhos.

Author	Number of species	Field collection
Dendy & Frederick (1924)	38	Dakin
Hooper (1989)	1	Hooper, USSR Research Vessel Akademik Oparin, NCI
Hooper (1991)	2	USSR Research Vessel Akademik Oparin, NCI
Hooper & Bergquist (1992)	1	USSR Research Vessel Akademik Oparin, NCI
Hooper & Lévi (1993)	1	USSR Research Vessel Akademik Oparin, NCI
Hooper (1996)	12	Hooper, USSR Research Vessel Akademik Oparin, WAM, NCI
Fromont (1998)	2	WAM, this study
TOTAL	57	

MATERIALS AND METHODS

Field trips were made to the islands in 1996 and 1997 to examine demosponges of the Abrolhos, and to determine timing and mode of reproductive activity of species collected. The latter results will be reported elsewhere. Two islands in two island groups were visited, Rat I. in the Easter Group (December 1996), and Beacon I., Wallabi Group (March 1997) (Fig.1). Sponge species were photographed in situ or soon after collection, a representative specimen of each species from each site was preserved in 70% ethanol, and deposited in the collections of the WAM. Relative abundance of species was estimated for each dive and summarised into 3 broad categories, + = 0-5 specimens, ++ = 5-10 specimens, and +++ = 10+ specimens seen per dive. The dominant habitat type studied on these field trips was coral reef, and intertidal reef flats at Rat I. (Table 2).

Abbreviations: CSIRO, Commonwealth Scientific and Industrial Research Organisation, Perth; NCI, Marine Bioproducts Group, Australian Institute of Marine Science, Townsville; QM, Queensland Museum, Brisbane; UWA, University of Western Australia, Perth; WAM, Western Australian Museum, Perth.

RESULTS

Seventy-seven species were recorded from the two localities examined in this study. Fourteen (18%) of these were common to both localities, 40 (52%) were reported only from Rat I. and 23 (30%) only from Beacon I. Of these, 28 (36%) have already been described in the literature (Table 3). Of the remaining 49 (64%) species, 14 were tentatively assigned to a known species but require

TABLE 2. Summary of fieldwork program undertaken at the Abrolhos for this study.

Island/ Island group	Subtidal SCUBA dives	Maximum depth (m)	Intertidal reef walks	Habitat (subtidal dives)
Rat I./ Easter Group	5	18	4	Coral reef slope (4), deep hole (1)
Beacon I./ Wallabi Group	5	25	0	Coral reef slope (2), deep outcrop (1), patch reefs (2)

TABLE 3. Sponge species previously reported in the literature and collected during this study at the Abrolhos. * original species name that has since been synonymised with species name given in the table (Hooper & Wiedenmayer, 1994); # probable species complexes. Localities: GBR = Great Barrier Reef, NA = N Australia, NSW = New South Wales, SA = S Australia, NT = Northern Territory, IPM = Indo Pacific/Malay, Vic = Victoria, IO = Indian Ocean, Tas = Tasmania, NWA, = NW Australia, Abrolh = Houtman Abrolhos, WA = W Australia, New Cale = New Caledonia. Abundance estimates: + = 0-5 specimens seen in 1 dive; ++ = 5-10 specimens; +++ = >10 specimens.

Identification	WAM no.	Rat I. Easter Group	Beacon I. Wallabi Group	NA	SA	IPM	IO	Other areas
Plakinastrella mammillaris Lendenfeld, 1907	Z1280	+	+	NWA	WA			
Plakinastrella minor (Dendy, 1916)	Z1279	-	-				X	Abrolh
**Ancorina acervus* (Bowerbank, 1862)	Z1198, 1199	++	-	GBR, NT		X	X	Red Sea
Erylus lendenfeldi Sollas, 1888	Z1278, 1281, 2241	-	-		SA		X	
Caulospongia amplexa Fromont (1998)	Z53	-	-	NWA				
Chondrilla australiensis Carter, 1873	Z1167, 1168, 1169, 1170, 1171, 1172, 1173	+++	+++		NSW, Vic	++	+	Red Sea
#*Spirastrella vagabunda* Ridley, 1884	Z1204	-	-	GBR, NT		X	X	
Sigmosceptrella fibrosa (Dendy, 1897)	Z1160, 1161, 1162, 1163, 1164	++	++		Vic, Tas			
Trachycladus laevispirulifer Carter, 1879	Z1185, 1186, 1187	+	+		NSW, Vic, Tas			
Axinella aruensis (Hentschel, 1912)	Z1275, 1276, 1284, 1285, 1376	++	+	NWA		X		
Cymbastela marshae Hooper & Bergquist, 1992	Z1176, 1177, 1178	++	-					Abrolh
Halichondria phakelliodes Dendy & Frederick, 1924	Z1180, 1181, 1182, 1183, 1184	++	-					Abrolh
Holopsamma favus (Carter, 1885)	Z1191	+	+	NWA	Vic, Tas			
Crella incrustans thielei Hentschel, 1911	Z1196, 1197	-	-		WA			
Crella spinulata (Hentschel, 1911)	Z1179	+	+	NWA, GBR, NT				New Cale
Phorbas fictitioides (Dendy & Frederick, 1924)	Z1158	-	-					Abrolh
Forcepia biceps (Carter, 1885)	Z1159	-	-		WA, Vic			
Iotrochota acerata Dendy, 1896	Z16	-	-		WA, Vic			
Iotrochota baculifera Ridley, 1884	Z1286, 1287, 1288, 1289, 1290	+++	++	NWA, NT		+	X	
Zyzzya massalis (Dendy, 1922)	Z1302	-	-			X	X	Abrolh
Mycale cockburnia Hentschel, 1911	Z1255, 1256, 1257, 1258	+	+		WA			
Mycale sulcata Hentschel, 1911	Z1297	-	-		WA			
#*Clathria (Thalysias) cactiformis* (Lamarck, 1814)	Z1259	-	-		WA, SA, NSW, Vic, Tas		X	
Clathria (Isociella) selachia Hooper, 1996	Z1282, 1283	-	-	NWA				
Echinodictyum clathrioides Hentschel, 1911	Z1195	-	-	NWA	WA			
Haliclona amboinensis (Lévi, 1961)	Z1406	+	-	GBR		X		
Haliclona cymaeformis (Esper, 1791)	Z1400, 1401, 1402	-	+++	NT, GBR		X	X	
**Lendenfeldia plicata* (Esper, 1806)	Z1201, 1202, 1203	++	-	NWA, Qld	WA, NSW	X	X	

TABLE 4. Undescribed species, and unconfirmed species identifications, collected during this study from the Abrolhos. Distributions: TR = tropical, ST = subtropical, TE = temperate, CO = cosmopolitan, Carrib = Carribean, Aust = Australia, NZ = New Zealand, Sth Afr = South Africa.

Identification	WAM no.	Rat I. Easter Group	Beacon I. Wallabi Group	TR	TR ST	TR ST TE	CO	Other regions
Plakortis sp. 1	Z1272, 1273, 1274	-	-		X			
Plakortis sp. 2	Z14, 1269, 1270, 1271, 2240	+	++		+			
Corticium cf. *simplex* Lendenfeld, 1907	Z1392	++	-		X			
Corticium cf. *candelabrum* Schmidt, 1862	Z1380	-	-		-			
Penares? cf. *intermedia* (Dendy, 1905)	Z1397	-	-			X		
Stelletta cf. *brevis* Hentschel, 1909	Z10, 1190	-	++			X		
Tethya cf. *multistella* Lendenfeld, 1888	Z1277	+	+			X		
Anthosigmella sp.	Z1303	-	-	X				Carrib
Aaptos sp.	Z1165, 1166	+++	-			X		
Theonella sp.	Z1242	-	-	X				
Agelas cf. *mauritiana* (Carter, 1883)	Z1200	-	-		X			
Agelas sp. 1	Z1193, 1194	X	-		X			
Agelas sp. 2	Z17	-	-		X			
Phycopsis sp.	Z1254	-	X	X		X		
Pararhapoxya sp.	Z1261	-	-			X		NZ
Dragmatella? sp.	Z1268	-	-					?
Cymbastela cf. *vespertina* Hooper & Bergquist, 1992	Z1174, 1175	-	-	X				
Neofibularia sp.	Z1391	-	-	X				
Iotrochota sp.	Z1291, 1292	+++	-	X				
Tedania cf. *anhelans* (Lieberkühn, 1859)	Z1296	++	-			X		
Ectyodoryx sp.	Z1301	+++	-			X		Bi-polar
Phoriospongia sp.	Z8, 1294	+++	-			X		Aust/ NZ
Guitarra sp.	Z1265, 1266, 1267	X	+			X		NZ/ Sth Afr
Liosina sp.	Z1205	-	-	X				
Clathria (Thalysias) cf. *abietina* (Lamarck, 1814)	Z1260	-	+				X	
Haliclona cf. *toxotes* (Hentschel, 1912)	Z1393, 1394, 1395, 1396	+	+				X	
Haliclona sp. 1	Z9, 11, 12, 1405, 2239	-	-				X	
Haliclona sp. 2	Z13	-	-				X	
Haliclona sp. 3	Z1399, 1403	-	++				X	
Reniera sp. 1	Z1375	-	-				X	
Reniera sp. 2	Z1384	-	-				X	
Reniera sp. 3	Z1384	++	-				X	
Reniera sp. 4	Z1381	-	-				X	
Gellius sp. 1	Z1379	-	-			X		
Niphates cf. *nitida* Fromont, 1993	Z1377, 1378	-	-			-		
Gelliodes cf. *obtusa* Hentschel, 1912	Z1250, 1251, 1252, 1253	+++	+			X		
Aka sp. 1	Z1263, 1264	+	+	X				

Table 4 *cont.*

Callyspongia sp. 1	Z1385	+	-			X		
Callyspongia sp. 2	Z1386	+	-			X		
Callyspongia sp. 3	Z1387	-	+			X		
Callyspongia sp. 4	Z1382	+	-			X		
Petrosia cf. *cancellata* Thiele, 1903	Z1388	-	+			X		
Strongylophora cf *strongylata* (Thiele, 1903)	Z1389	-	+	X				
Spongia sp.	Z15	-	+		X			
Psammocinia sp.	Z1262	+	-			X		
Dysidea sp.	Z1299	+	-			X		
Spongionella sp.	Z1390	+	-				X	
Dendrilla sp.	Z1300	+	-			X		
Pseudoceratina sp.	Z1192	+	-	X				

confirmation by comparison with type material, and 35 are probably new (Table 4).

Of the 28 known species reported from the Abrolhos in this study 15 (13%) had previously been reported from this locality. Two of these, *Ancorina brevidens* Dendy & Frederick (1924) and *Megalopastas arenifibrosa* Dendy & Frederick (1924), have since been synonymised with more widespread species, *A. acervus* (Bowerbank, 1862) and *Leudenfeldia plicata* (Esper, 1806) respectively, by Hooper & Wiedenmayer (1994). Three species are apparent endemics for the Abrolhos: *Cymbastela marshae* Hooper & Bergquist (1992), *Halichondria phakelloides* Dendy & Frederick (1924) and *Phorbas fictitioides* Dendy & Frederick (1924). For 2 species, *Plakinastrella minor* (Dendy, 1916) and *Zyzza massalis* (Dendy, 1922), the Abrolhos is so far their only Australian locality (Hooper & Krasochin, 1989 & this study). Two species are new records for WA; *Haliclona amboinensis* (Lévi, 1961) and *H. cymaeformis* (Esper, 1791).

A further 14 species are known in the literature, but either some of their taxonomic characters were significantly different from published descriptions, or conspecificity would have produced highly disjunct distributions. In both these cases examination of type material is required to confirm identities, this has not yet been possible. These species are presently prefixed with 'cf' (Table 4). Thirty five species could only be identified to genus and are probably new (Table 4). Generic distributions are presented as per Van Soest (1994) and in the case of the 14 unconfirmed identifications, the known distribution of these species as reported in the literature.

Three of the genera reported here represent new records for Australia. *Anthosigmella* has been previously reported only from the Carribbean (see Wiedenmayer, 1977), *Guitarra* from South Africa (Lévi, 1963), New Zealand (Brondsted, 1924; Dendy, 1924; Bergquist & Fromont, 1988), and E Pacific coast (Desqueyroux Faundez & Van Soest, 1997) and *Liosina* from Papua New Guinea (Kelly Borges & Bergquist, 1988) and Bawi Island, Zanzibar, Tanzania (Kelly-Borges, 1998).

DISCUSSION

This study increases the total number of demosponge species reported from the Abrolhos from 57 to 109. This number of species is likely to represent only a small proportion of the total sponge fauna of these islands considering only two islands in two of the four island groups were surveyed; none of the algal-dominated areas have yet been visited; and depths were restricted to less than 18 and 25m respectively. A similar style of sponge collection, but with a much larger number of sampling sites, was undertaken on the NW. Australian oceanic reefs of Ashmore, Cartier and Hibernia, from which 138 species were reported (Hooper, 1994). The 109 species so far reported from the Abrolhos therefore indicates there is a very rich sponge fauna around these islands.

Fourteen of the 77 species collected during this study were common to both sites, but 40 (52%) of the remainder of species occurred only at Rat I. and 23 species (30%) at Beacon I. These differences in species compositions may indicate fundamental differences between the islands in a proportion of their sponge biota. For example, the 4 island groups are separated by channels of approximately 40m depth which may restrict movement between island groups of gametes of some species. It is also possible that there are

TABLE 5. Species previously described from the Abrolhos but not recollected during this study. * original species name that has since been synonymised with the species name given in the table (Hooper & Weidenmayer, 1994); # may be a species introduced via shipping. Localities: NA = N Australia, SA = S Australia, IPM = Indo Pacific/Malay, IO = Indian Ocean, NWA = NW Australia, WA = W Australia, GBR = Great Barrier Reef, Qld = Queensland, NSW = New South Wales, NT = Northern Territory, Vic = Victoria, Tas = Tasmania, Abrolh = Abrolhos, NZ = New Zealand, Sth Afr = South Africa, Subant = Subantarctic.

Species	NA	SA	IPM	IO	Other areas
Stelletta debilis Thiele, 1900			X		Abrol
Stelletta sigmatriaena Lendenfeld, 1907	NWA				
Ancorina australienesis (Carter, 1883)		WA			
Rhabdastrella rowi (Dendy, 1916)				X	Abrol
Asteropus simplex (Carter, 1879)	Qld, NWA	WA, Vic	X		NZ, Easter I
Erylus proximus Dendy, 1916				X	Abrol
Tethya robusta (Bowerbank, 1859)	Qld	WA	X	X	Red Sea
**Xestospongia similis* (Ridley & Dendy, 1886)	NT	WA, NSW	X	X	Subant
**Callyspongia mollis* (Lendenfeld, 1887)		NSW			Abrol
**Callyspongia ramosa* (Gray, 1843)	Qld	Tas, NSW, Vic	X		NZ, Subant
Oceanapia abrolhosensis (Dendy & Frederick, 1924)					Abrol.
**Mycale parasitica* (Carter, 1885)		TAS, NSW, Vic		X	
Mycale trichophora (Dendy & Frederick, 1924)					Abrol
#**Mycale parishi* (Bowerbank, 1875)	NT, NWA	WA, NSW	X	X	Sth. Afr
Biemna tubulata (Dendy, 1905)				X	Abrol
Waldoschmittia schmidti (Ridley, 1884)		WA, Tas, NSW, Vic	X	X	
Holopsamma crassa Carter, 1885		Tas, NSW, Vic			
Dysidea dakini (Dendy & Frederick, 1924)					Abrol
Hyatella intestinalis (Lamarck, 1814)	GBR, NWA	WA,	X	X	
**Coscinoderma pesleonis* (Lamarck, 1814)		Vic, Tas, WA			
Echinodictyum nidulus Hentschel, 1911	NWA, NT				
Clathria (Wilsonella) abrolhosensis Hooper, 1996					Abrol
Clathria (Wilsonella) australiensis (Carter, 1885)		NSW			
Clathria (Microciona) grisea (Hentschel, 1911)	NWA				
Clathria (Dendrocia) pyramida Lendenfeld, 1888		NSW			
Clathria (Axociella) patula Hooper, 1996	NWA				
Clathria (Thalysias) aphylla Hooper, 1996					Abrol
Clathria (Thalysias) cancellaria (Lamarck, 1814)	NWA				
Clathria (Thalysias) styloprothesis Hooper, 1996		WA			
Antho (Antho) tuberosa (Hentschel, 1911)	NWA			X	
Holopsamma arborea (Lendenfeld, 1888)	NWA	WA, NSW			
Caulospongia plicata Saville Kent, 1871	NWA				

significant microhabitat differences between these islands, thus influencing species composition of each island (cf. Hooper, 1994), but this has not been investigated.

One of the aims of this study was to determine if the sponges of the Abrolhos were principally tropical or temperate in origin. For this reason a list of species previously recorded from the Abrolhos, but not recollected during this study, is included (Table 5). Inclusion of this dataset (Table 5) brings the number of species known to be endemic to the Abrolhos to a total of 8, 3 recollected during this study (noted above) and 5 others: *Mycale trichophora* Dendy & Frederick (1924), *Dysidea dakini* Dendy & Frederick (1924), *Oceanapia abrolhosensis* (Dendy & Frederick, 1924), *Clathria (Wilsonella) abrolhosensis* Hooper (1996), and *C. (Thalysias) aphylla* Hooper (1996). Whether these species are true endemics to the islands, or more widely distributed but not yet reported, will not be

TABLE 6. Proportion of tropical, temperate and endemic species of sponges occurring at the Abrolhos.

No. of species	Trop.	Trop. & Temp.	Temp.	Endemic Abrol	Endemic WA
In this study	9	5	11	3	6
Reported in previous studies	8	7	12	5	7
Total	17 (28%)	12 (20%)	23 (38%)	8 (13%)	13

known until further work is undertaken in adjacent temperate and tropical localities in WA.

In addressing tropical and temperate origins of species, those identified only to genus, or with unconfirmed identifications, were excluded (Table 4). The majority of known species (Tables 3, 5) are of temperate origin. Twenty-three species (38%) are known from temperate waters, 17 species (28%) are tropical and 12 (20%) have a more widespread tropical and temperate distribution. Thirteen species are only known so far from WA, and appear to be endemic to the State. Their distribution as either temperate or tropical, or both, is incorporated into these categorics in Table 6.

This biogeographic analysis of sponges of the Abrolhos is considered preliminary given that a large component of the fauna is presently excluded from the assessment. However, these data on proportions of temperate versus tropical species are in marked contrast to other marine biota reported from these islands. For most phyla there is a greater component of tropical than temperate species in the fauna (Table 7); echinoderms, molluscs and fishes have similar proportions of tropical versus temperate species. In contrast, sponges have a greater temperate component; amongst other phyla only seagrasses show a temperate species dominance. Should this apparent dominance of temperate sponge species be eventually confirmed, it may be the result of: 1) The reproductive biology of the sponges, whereby some species are known to have benthic larvae which may not have the temporal capability to survive a migration on the Leeuwin current. This would reduce the proportion of tropical species able to recruit to the islands. 2) The Leeuwin current is known to have been in existence since the Eocene (40 m.y.a.), and has continued to occur in pulses since this time. Periods when the current has not flowed may have allowed for recruitment of temperate species from the adjacent coastline.

In summary, this study doubles the number of demosponges reported from the Abrolhos. First indications are that the sponge fauna is relatively species rich, with a larger number of temperate than tropical species. Much work remains to fully document the fauna, including in the North and Pelsaert Island groups, algal dominated reefs, and greater depths than sampled here.

Until the sponge fauna of localities both N and S of the Abrolhos, and on the adjacent W coast of Australia are better documented, this work remains a study in isolation. Consequently, conclusions on species endemicity remain tentative, and the affinities of the undescribed component of the fauna are not presently known.

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TABLE 7. Proportions of tropical and temperate components of marine phyla studied at the Abrolhos. * total number of different species, including 49 as yet unnamed and 60 named.

Phylum	Tropical (%)	Subtropical (%)	Temperate (%)	Temp. & Trop. (%)	Endemic Abrol (%)	Endemic WA (%)	Total species
Porifera (Demospongiae)	28		39	20	13		60 (109*)
Echinoderms (Marsh, 1994)	64		15			21	172
Molluscs (Wells & Bryce, 1997)	69		20			11	492
Fish (Hutchins, 1997)	67	13	20				389
Seagrasses (Brearley, 1997)	30		70				10

from the Abrolhos. Two referees provided useful comments on the manuscript. I acknowledge the assistance of Fisheries Western Australia, Geraldton office; Kim Nardi for logistical fieldwork support, and Randall Owens for helpful advice on diving localities and assistance at the islands. I thank the crew of the P.V. McLaughlin for transport to Rat I., the captain, Ray Howarth and crew of Island Leader for transporting equipment to Beacon I. Mr Dramsfield and the fishers and families of Beacon I. were welcoming and provided useful local advice. Thanks to L. Matz, Bruce Beaney and staff of the Histopathology Lab. of Royal Perth Hospital for allowing me use of their microtomes. The Australian Biological Resources Study (ABRS) for providing funding allowing me to participate in the 5th International Sponge Symposium, 'Origin & Outlook' in Brisbane, Australia, and for funding this study which was carried out at the Museum of Natural Science, Perth, Western Australia.

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